

We claim:

1. An optical micro-switch comprising:  
a generally planar substrate;  
a first optical input/output port;  
a plurality of second optical input/output ports; and  
an optical guiding assembly operatively coupling first optical input/output port to at least one of said plurality of second optical input/output ports along one of plural optical paths, each of said optical paths being generally parallel to said generally planar substrate, the optical guiding assembly configured to moveably direct an optical signal between the first optical input/output port and a selected one of the plurality of second optical input/output ports.

2. The optical switch of claim 1, wherein the optical guiding assembly further includes:  
a optical micro-element assembly including an optical microelement; and  
an actuator assembly coupled to the optical micro-element assembly, the actuator assembly configured to move at least said optical micro-element substantially parallel to said generally planar substrate to a predetermined position so that said optical micro-element directs optical signals along a selected optical path between said first optical

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10 input/output port to a selected one of said plurality of second optical  
11 input/output ports.

1 3. The optical switch of claim 2, wherein the actuator assembly  
2 further includes a horizontal electrostatic comb drive.

1 4. The optical switch of claim 2, wherein the optical micro-element  
2 includes a lens mounted to have an intended optical path generally  
3 parallel to said generally planar substrate.

1 5. The optical switch of claim 2, wherein the optical micro-element  
2 includes an optical glass ball lens.

1 6. The optical switch of claim 2 wherein there are at least three  
2 second optical input/output ports, said optical micro-element assembly  
3 switching said optical micro-element to plural positions corresponding in  
4 number to the number of said plurality of second optical input/output  
5 ports.

1 7. An optical micro-switch comprising:  
2 a first optical input/output port;  
3 a plurality of second optical input/output ports; and

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4 an optical guiding assembly operatively coupling first optical  
5 input/output port to at least one of said plurality of second optical  
6 input/output ports along one of plural optical paths, said optical guiding  
7 assembly including,

8 a horizontal electrostatic comb drive, and  
9 an optical micro-element operably connected to said comb  
10 drive,

11 said comb drive moving said optical micro-element to plural  
12 positions greater than two and corresponding in number to plural  
13 input/output ports, to direct an optical signal between said first  
14 optical port and a selected one of said second optical input/output  
15 ports.

1 8. The optical micro-switch of claim 7 wherein at least one of said  
2 input and output ports has plural channels.

1 9. The optical switch of claim 7, wherein the actuator assembly  
2 further includes a horizontal electrostatic comb drive.

1 10. The optical switch of claim 7, wherein the optical micro-element  
2 includes an lens mounted to have an intended optical path generally  
3 parallel to said generally planar substrate.

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1 11. The optical switch of claim 7, wherein the optical micro-element  
2 includes an optical glass ball lens.

1 12. A method for switching an optical signal between a first optical  
2 input/output port and at least one of a plurality of second optical  
3 input/output ports the method comprising:

- 4 a) providing said first and second optical input/output ports in  
5 an arrangement generally parallel to a generally planar supporting  
6 substrate;  
7 b) providing an micro-optical element between said first optical  
8 input/output port and said plurality of second optical input/output  
9 ports, an optical path generally parallel to said supporting substrate  
10 being defined between said first optical input/output port and said  
11 micro-optical element;  
12 c) directing the optical signal between the first optical  
13 input/output port and a selected one of the plurality of second  
14 optical input/output ports by shifting said micro-optical element in  
15 a direction transverse to said optical path.

1 13. The method of claim 12 wherein there are at least three second  
2 optical input/output ports, said step c) of directing switching said optical  
3 micro-element to plural positions corresponding in number to the number  
4 of said plural second optical input/output ports.

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1 14. The method of claim 12, wherein the actuator assembly further  
2 includes a horizontal electrostatic comb drive.

1 15. The method of claim 12, wherein the optical micro-element  
2 assembly includes an etched lens.

1 16. The method of claim 12, wherein the optical micro-element  
2 assembly includes an optical glass ball lens.

1 17. The method of claim 12, wherein the optical micro-element  
2 assembly includes a mirror.

1 18. An optical switch comprising:  
2 a generally planar substrate;  
3 an actuating assembly integrated into the substrate; and  
4 an optical micro-element integrated into the actuating assembly,  
5 wherein the optical micro-element has an optical axis parallel to the plane  
6 of said substrate, and wherein the actuating assembly is configured to  
7 move the optical micro-element parallel to the plane of said substrate.

1 19. The optical switch of claim 13, further comprising:  
2 an first input/output port; and

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3 a plurality of second input/output ports, wherein an optical signal  
4 is directed to a selected one of the plurality of second input/output ports  
5 from the first input/output port by driving an actuator to move the optical  
6 micro-element within the plane of said substrate, said actuator being an  
7 horizontal electrostatic comb drive.

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